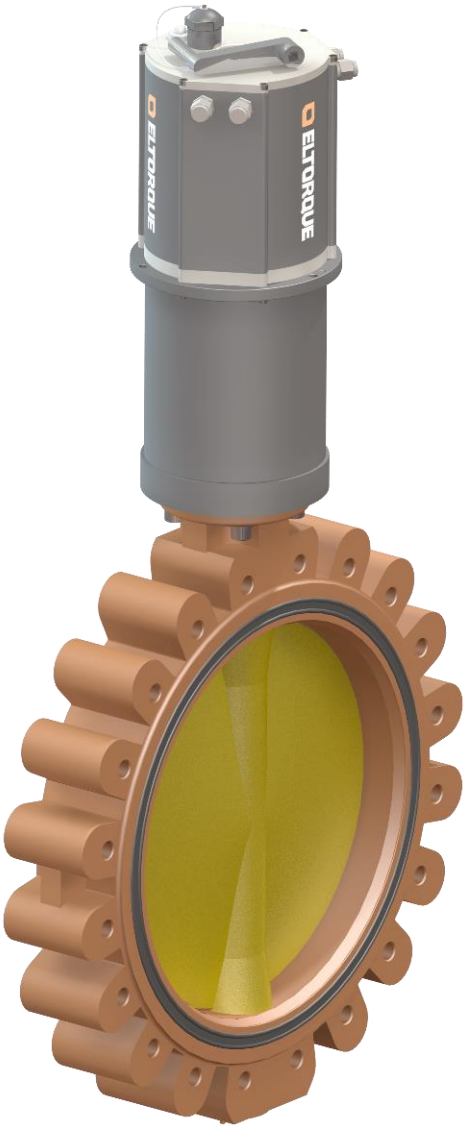
ELTORQUE

User Manual



QT4000
Electrical Part-turn Valve Actuator

Revision Date: 29.09.2014
Author: Bjørn Nybrodahl

Revision history

Revision number	Revision date	Done by	Approved by	Changes
1	28.04.2014	TR	BN	First version
2	29.09.2014	JBR	BN	Tech data.,

Referenced documentation

Technical Manual_ Eltorque Interfaces_QT2500_4000
Eltorque Manager 3 Manual

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1. INTRODUCTION

Eltorque offers a model range of electric valve actuators suitable for use in a wide variety of industrial environments.

The Eltorque actuators are characterized by:

- Compact size and good torque to size/ weight ratio
- Flexible control interfaces for easy integration with a wide range of control systems
- Low power consumption
- Electronic configuration of speed, torque and other parameters
- Easy and cost effective installation
- Maintenance free

The QT4000 is suitable for use on part-turn valves with an operating torque between 2500 and 4000 Nm. Most part-turn valves utilize quarter-turn (90°) movement, but the QT4000 can easily be configured to an operation area within the range 0-359°. During the purchasing process, it is important to consider the following parameters:

Valve interface
It must be checked that the spindle and valve mounting holes either fit directly onto the actuator or alternatively consider spindle adapters and valve brackets. The QT4000 has replaceable guidance ring and valve adapter, which can be customized to fit directly onto most valves.

Max operation torque
The actuator must have sufficient torque to operate the valve in all applicable conditions. The QT4000's maximum torque will decrease below 4000 Nm at motor speeds above 120 rpm, but speed can be set lower and torque higher in the valve's near closed region

Closing time
This is usually determined as a part of the process development. In some cases, the closing time should be as short as possible if the valve for example is shutting down a system in case of failure. In other cases it is desired with a longer closing time to avoid shock waves in pipe systems with high pressure or flow.

Remote Control
The QT4000 can be controlled remotely by four different types of control:

- Digital (Open-Close)
- Analogue (4-20 mA)
- Modbus (Fieldbus, max 31 actuators per network)
- CANopen (Fieldbus, max 127 actuators per network)

For more details about the functionality of these Control Interfaces, refer to the "Technical Manual – Control interfaces for Eltorque QT4000 Valve actuators".

Additionally, the actuator can be configured and controlled from a standard computer using a dedicated cable and software tool; Eltorque Manager 3.

2. SPECIFICATIONS AND MANUAL OPERATION

2.1 Technical data

	QT4000
Torque	2500 - 4000 Nm*
Closing time	0-90° movement: 45-140 sec*
Dimensions (HxWxD)	540 x 273 x 247 mm
Weight	69 kg incl. Valve Adapter and Guidance ring**
Valve flanges**	F16 (According to ISO5211)
Standard valve adapter**	SQ46
Encapsulation	IP68 (5m 1 hr) Corrosion protected aluminium and steel enclosure
Operation temperature	-25 – 55 °C
Color	Black
Control interfaces	Digital (Open-Close), Analogue (4-20 mA) CANopen and Modbus Fieldbus
Position sensor	Range: 360° - 0,4° resolution Position feedback not corrupted by power failure
Power supply	110-240 V AC/ DC, 50/60 Hz, Max 480VA
Over/ under temperature protection	Motor current is switched off in case of over-temperature Stator coils utilized as heating elements in case of low temperatures
Manual operation	Manual override without tools, max 9 Nm torque 100 turns on crank handle = 90° movement on valve

* Configurable using Eltorque Manager Software.
** Guidance ring and valve adapter can be customized on request.

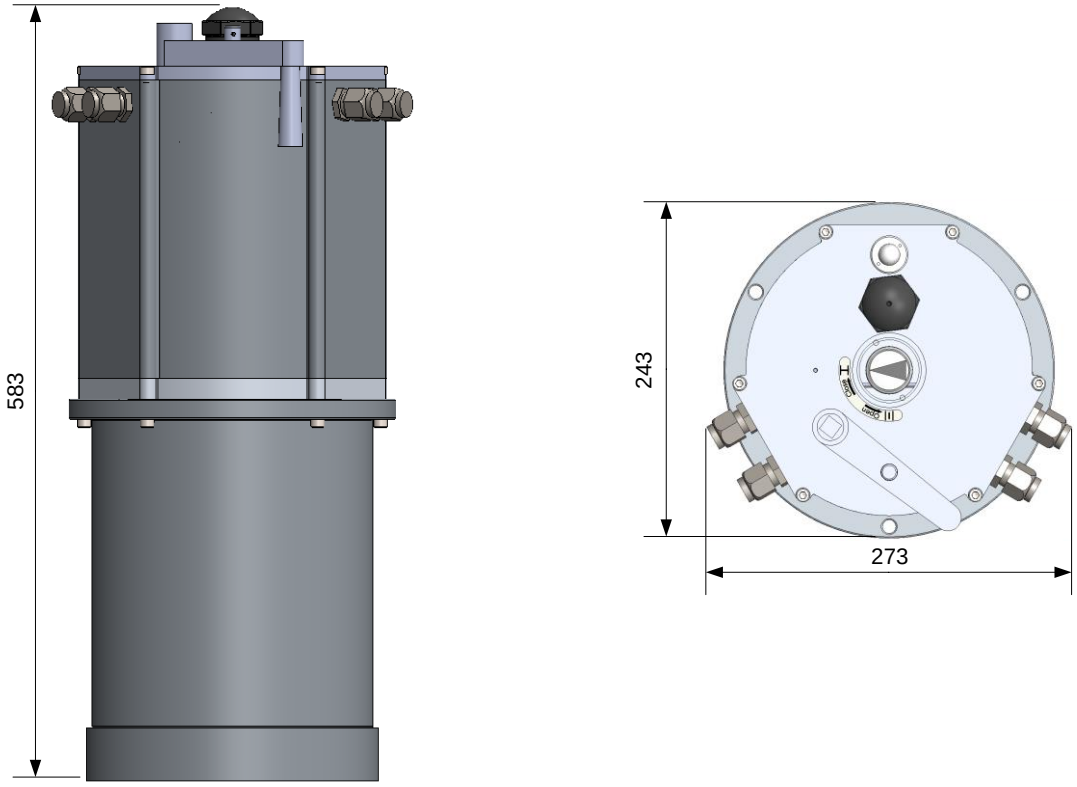


Fig. 1: External measurements

2.2 External construction

1. Motor and electronics housing.
2. Gear housing.
3. Cable glands for control signal cables.
4. Cable glands for power supply cables.
5. Status indicator light
   Red = Alarm
   Yellow = Standby Closed (Blinking = Closing)
   Green = Standby Open (Blinking = Opening)
   Green short flash = Standby Positioned
   Red – Yellow – Green sequence =
   Actuator is re-booting.
6. Cover for manual operation shaft
7. Valve position indicator
8. Top cover
9. Crank handle for manual operation
10. Guidance ring fastening screws
11. Guidance ring with valve flange
12. Valve spindle adapter
13. Lifting devices, max 80 kg load each

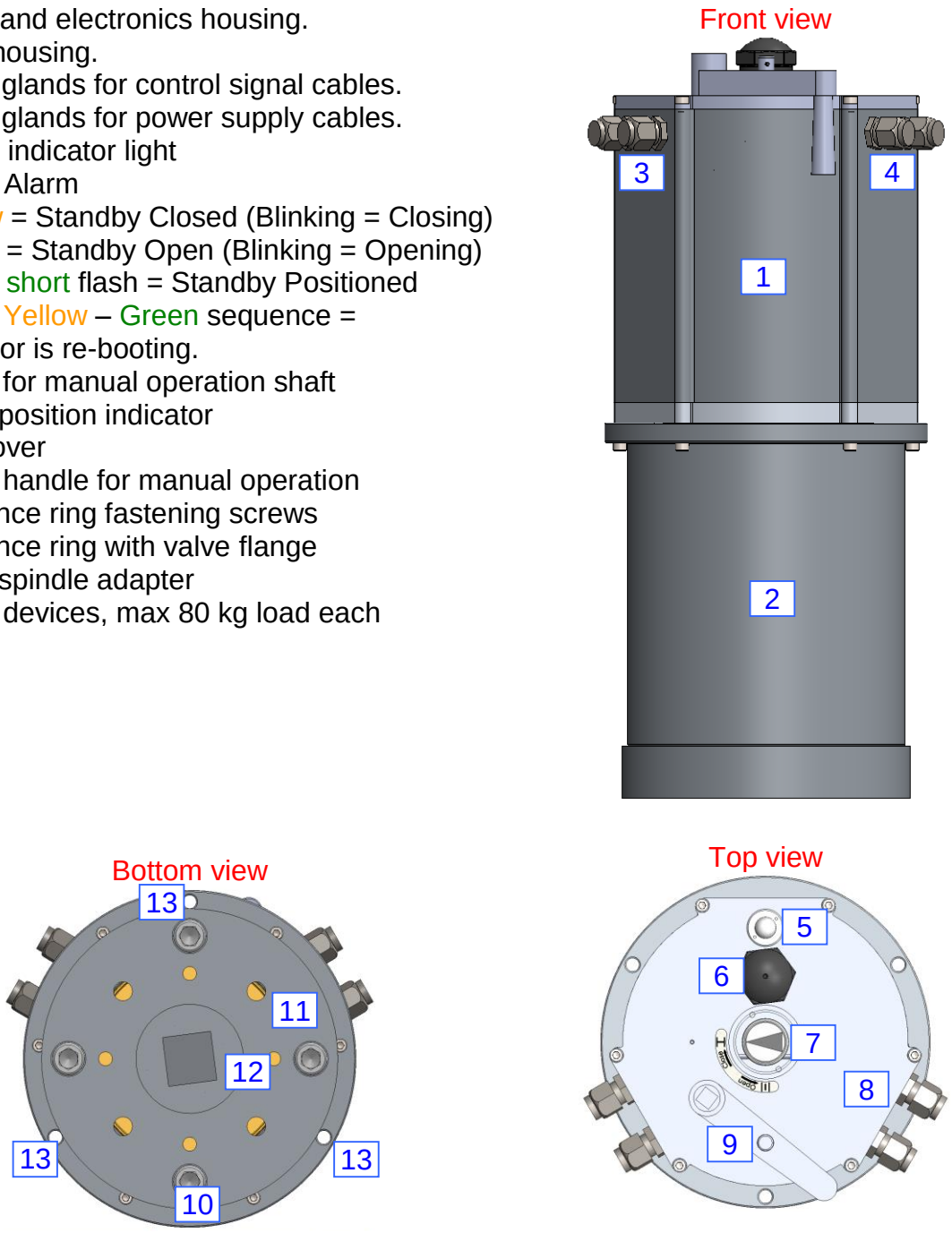


Fig. 2: External construction

2.3 Operating conditions

The QT4000 is especially suitable for use below deck on ships and other offshore vessels due to its compact design, low power consumption and robust construction.
It can also be used in other applications as long as the following criteria are met:

- Operating temperature is kept within specified limits.
- Actuator is placed indoors and not exposed to direct sunlight.
- Protected from extensive corrosive atmospheres like on open deck of ships or other areas exposed to salt water spray. Cleaning with strong alkaline or acidic chemicals can also cause corrosion problems.
- Actuator must not be placed in hazardous areas where the presence of explosive atmospheres might cause explosion hazard.

2.4 Actuator duty type

When electric valve actuators operate, they generate internal heat due to thermal loss in motor and –control electronics. The QT4000 combines low power consumption with high efficiency to ensure that internal thermal loss is kept low.
Still, duty cycle needs to be considered when designing the valve control system to ensure that the actuators can operate the valves without over-heating.
In case the actuator's internal temperature becomes too high, it will send out an alarm signal via the control interface. Should the temperature continue to rise, the actuator will shut down the motor until temperature decreases to a safe level.
To avoid problems with over-temperature alarms and actuator shutting down, duty cycle requirements should be considered before selecting actuator.

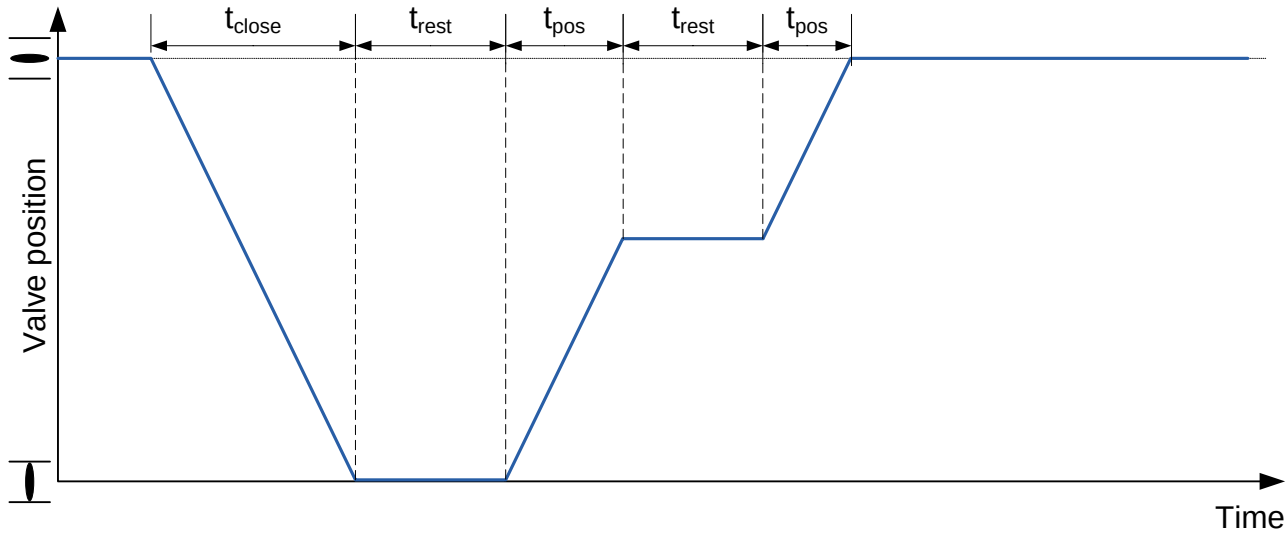


Fig. 3: Open-Close and positioning duty

Actuators used for Open-Close duty either open or close the valves, intermediate positions are not approached. The valves are rarely operated and the interval between operations may be a few minutes or even several months.
Open-Close duty will be relevant for QT4000 actuators with Digital control interface.
Actuators used for positioning duty will approach defined intermediate positions to set a static flow through a pipeline, applicable positions also include Open and Closed.
Positioning duty will be relevant for QT4000 actuators with Analogue or Fieldbus Interface.
For both these duty types, the same maximum continuous running time (t_{close} or t_{pos}) is 5 minutes followed by a rest period (t_{rest}) of minimum 5 minutes.

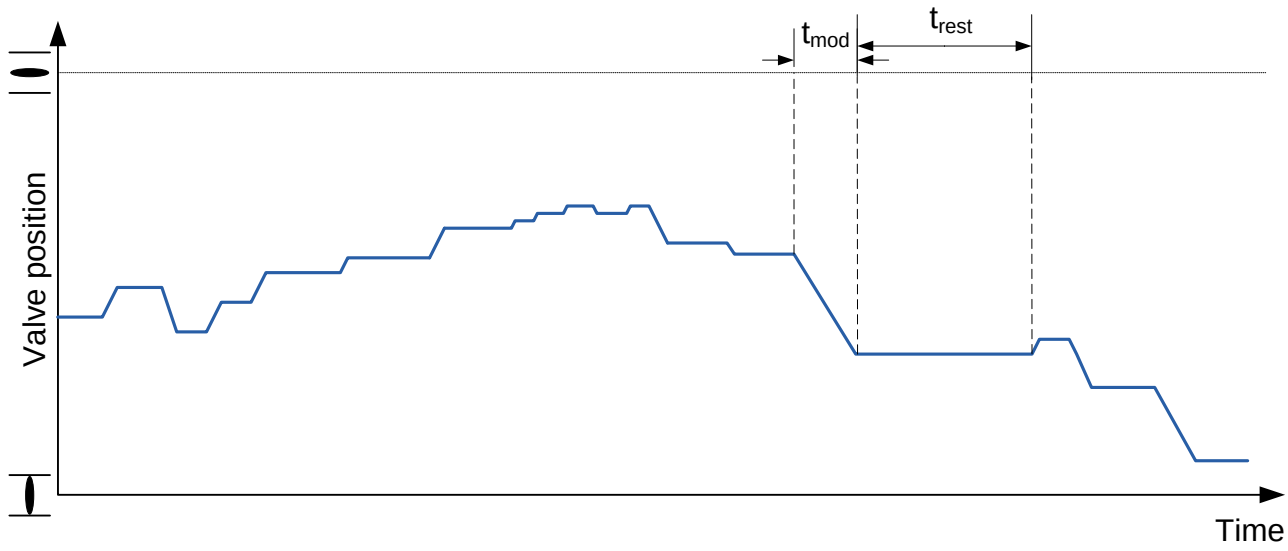


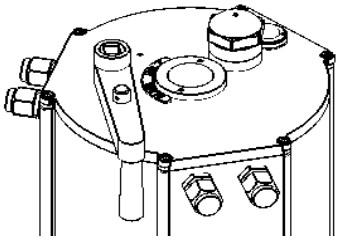
Fig. 4: Modulating duty

Modulating duty applies for actuators used on control valves where accurate and quick control of flow, level, temperature etc. is desired. The actuators will be controlled automatically by a regulator or PLC depending on process data from sensors like flow meters, level- and temperature sensors, and some applications might require valve position adjustments within intervals of a few seconds.
This kind of operation puts higher demand on the actuator in terms of accuracy, wear resistance, low internal heat generation and good heat dissipation.
Modulating duty is relevant for QT4000 with Analogue or Fieldbus Interfaces.
Running time for modulating duty is limited by the relative on-time: $t_{mod} / t_{rest} < 0,5$.

The duty type limitations stated above applies for maximum operation temperature, and torque, see section 2.1.
If operating temperatures and or torque are lower, the actuator can be operated more than the duty type limitations stated above.

2.5 Manual operation

In case of power failure, control system error or another fault preventing normal operation of the actuator, it can be operated manually without the need of additional tools:



1. Unscrew and remove **M**anual **O**peration shaft cover.
2. Loosen the spring spline holding the crank handle.
3. Attach crank handle on MO shaft.
4. Turn Clockwise to close or Counter-clockwise to open valve.
   Valve position can be seen on the visual indicator in the center of the actuator's top cover.
5. When MO is completed, remove crank handle and refit it onto its holder.
6. Refit spring spline and MO shaft cover.

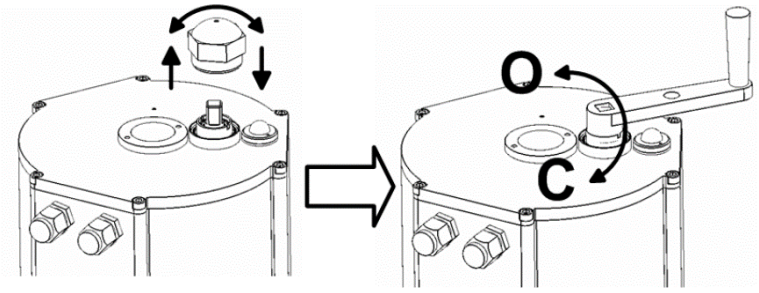


Fig. 5: Manual operation

Note: The actuator has a sensor which is sensing that the MO shaft cover is removed. Actuator cannot be operated remotely until the cover is replaced and tightened against the top cover. The actuator's indicator LED will be Red when cover is removed and motor current will be switched off.

3. INSTALLATION

3.1 Mounting actuator on valve

Before mounting actuator, please make sure there is sufficient space for manual operation above and around it.

1. Apply grease on valve spindle to ease mounting and avoid corrosion.
2. Lift actuator onto valve utilizing the 3 lifting devices on the actuator's center flange.
   Align valve spindle with valve adapter and lower actuator onto valve flange.
   Note: Keep hands away from the valve flanges to avoid crushing damages.
3. Use crank handle on manual operation shaft to turn actuator and align fastening holes of the valve flanges.
   Note: In order to achieve optimal functionality of valve position indicator, actuator should be positioned as shown on Fig. 5.
4. Insert valve fastening screws and if applicable lock washers.
5. Tighten fastening screws to the specified torque

Fig. 6: QT4000 on valve.

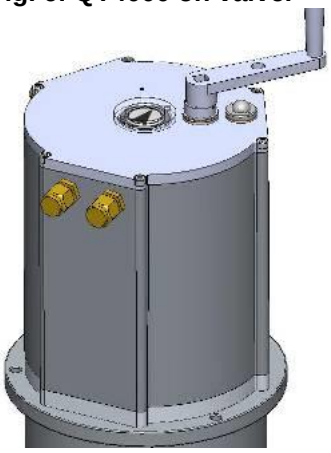


Fig. 7: Position adjustment.

3.2 Electrical installation

Electrical installation can only be designed and made by personnel with the appropriate skills and competence. Ensure all such work is done according to applicable laws and regulations.

1. Loosen the top cover fastening screws.
2. Remove actuator's top cover to gain access to connection terminals.

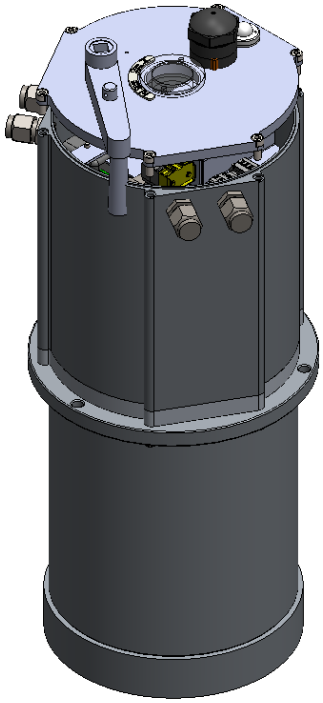
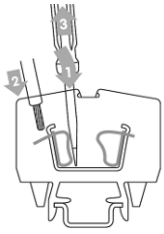


Fig. 8: Removing top cover.

Make sure fuses are disconnected before connection of power supply cables is started.

3. Install the power supply cables through the cable glands on the right side and connect them to the L, N and PE/ GND terminals:



4. Install the control signal cables through the cable glands on the left and connect them according to specification below.

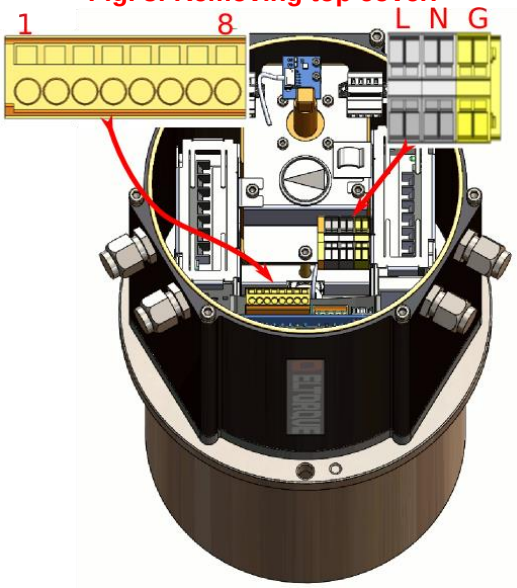


Fig. 9: Connection terminals location.

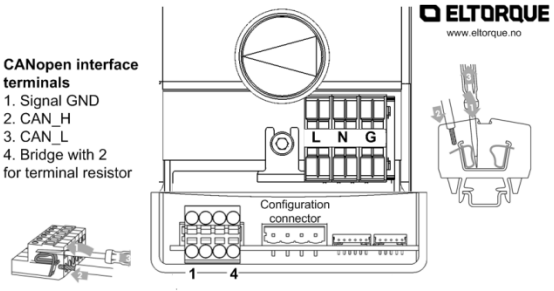


Fig. 10: QT4000 control interface terminals.

Control Interface functionality, cable recommendations etc. is described in the ”Technical Manual_Eltorque Interfaces”.

3.3 Configuration of actuator

The QT4000 actuator is configured electronically using the Eltorque Manager 3 software and a USB configuration cable. Manager 3 is distributed by e-mail or can be downloaded from our website, while the configuration cable can be purchased from local Eltorque distributor or the head office in Norway. (See page 1 for contact information)

The following parameters can be configured:
- End positions – Closed and Open.
- Speed, Torque and Near Closed region.
- Fieldbus address/ Node ID for CANopen and Modbus.
- Invertion of input and output for Digital and Analogue.

End positions and fieldbus address are mandatory, while the other parameters can be changed to achieve better valve control performance.

1. Install Eltorque Manager 3 and if required driver for configuration cable on your computer.

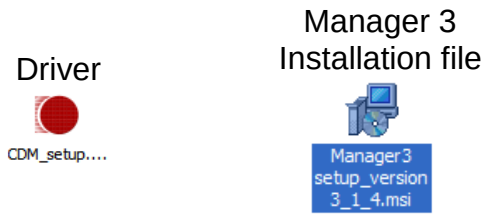


Fig. 11: Eltorque Manager 3 installation files.

2. Connect configuration cable to a USB port on your computer.
3. Start Manager 3

4. Connect cable to Actuator's configuration connector.

Make sure actuator has power and that the indicator LED is lit before attempting to connect actuator with Eltorque Manager 3.

Fig. 12: Connection of configuration cable.

5. Press ***Connect*** to establish communication with the actuator.
6. Select appropriate configuration values depending on valve and control system, see section 3.4 for more information.
7. Use Crank Handle to move actuator and valve to closed position.
   Press ***Set C&O*** and Closed is set to the actual position, while Open is set 90° away in counter clockwise direction. If further adjustment of end positions are required, move actuator to desired position and press ***Set Closed*** or ***Set Open.***
8. Press ***Hall Disable*** and ***Open*** to move valve to open position.
9. Press ***Close*** to close valve again.
10. Disconnect configuration cable and refit top cover.
11. Check that indicator LED changes from Red to Yellow when top cover is in place.

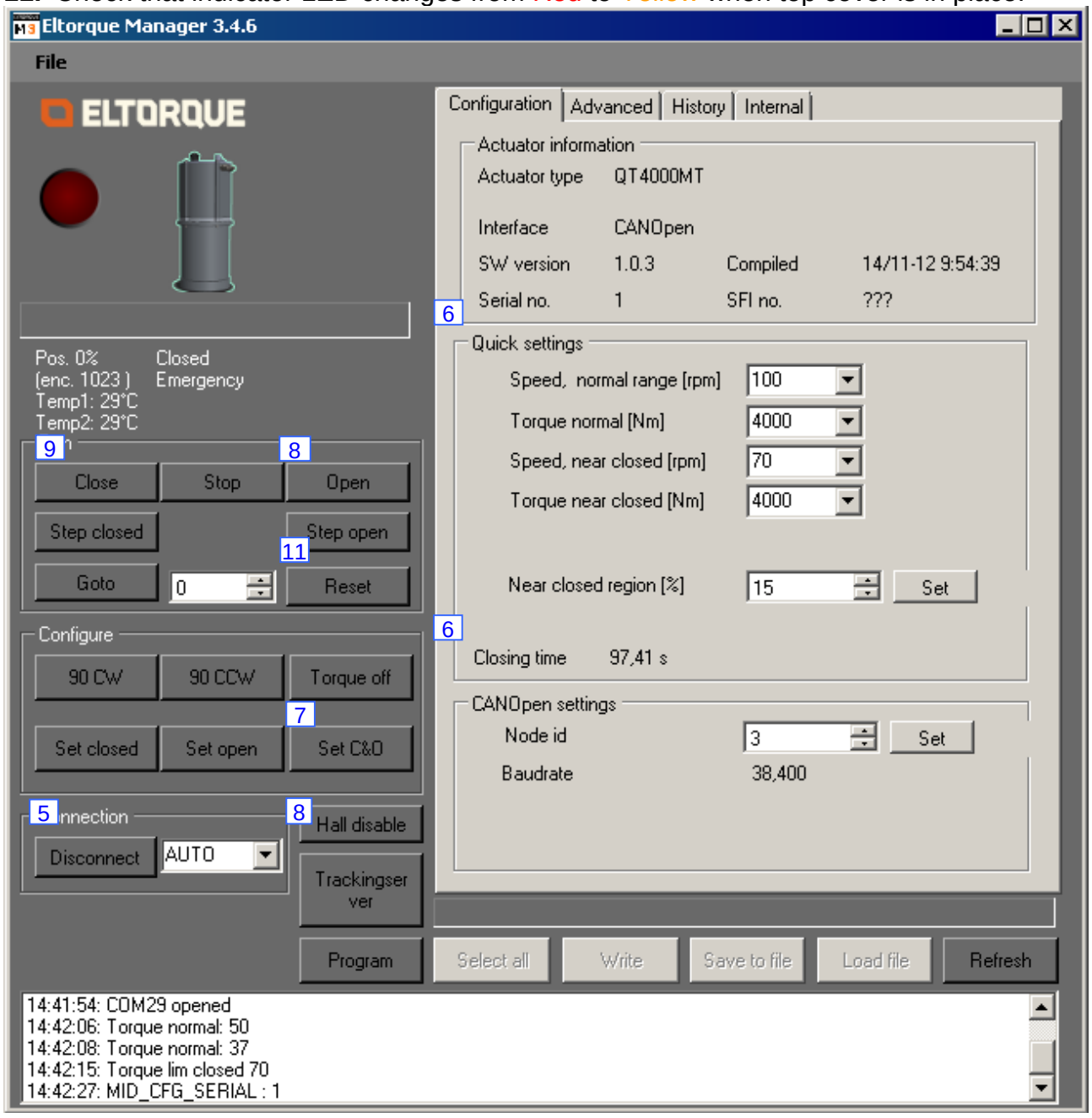


Fig. 13: Eltorque Manager 3 screenshot

For more information about the functionality of the software, please refer to the Eltorque Manager 3 Manual.

3.4 Selecting correct configuration

The QT4000 offers an easy but advanced configuration set-up, which allows accurate adjustments depending on valve and control system characteristics.
Please consider the following items when selecting configuration values:

- The actuator's output torque is limited to 4000 Nm for motor speeds above 150 rpm.
- Set torque values according to valve's torque specifications with a suitable safety margin. If torque is set too high, the valve might be damaged in case it is blocked by e.g. foreign objects inside pipe.
- On butterfly valves, the maximum torque is required to move disc in and out of gasket. Hence should only the torque in the near closed region be set according to the valve's specified operation torque. Torque in the travel area will be considerably lower.
- Ball valves tend to have a constant torque through the whole operation area, but the maximum torque is reached when the valve movement starts, so called "breakaway" torque.
- The actual operation torque of the valve can be checked by attaching a torque wrench with measuring gauge to the manual operation shaft of the actuator.
  The shaft has a 12x12 mm square on the end, hence can a standard ½" pipe socket fit onto it. Torque wrench must have a torque range of at least 0-10 Nm and accuracy of 0,25 Nm. Output torque is calculated by multiplying measured torque with a factor of 452, i.e. 9,0 Nm corresponds to 4000 Nm.

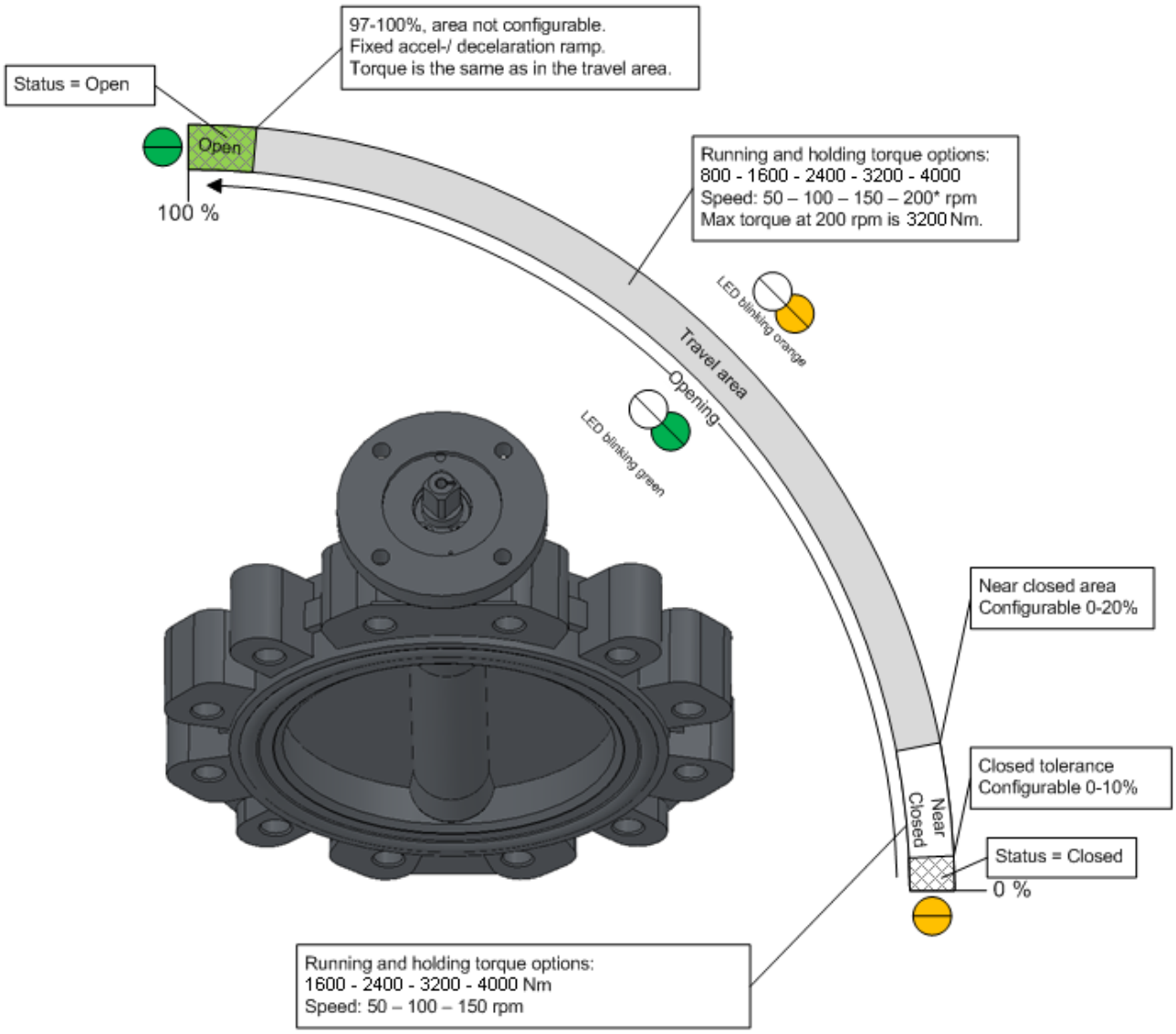


Fig. 14: Torque, speed and region settings.

- Under Fieldbus settings you can set the Node ID of actuators with CANopen or Modbus Control Interface. It is important that all actuators in the network have a unique Node ID and that it is set correctly according to the layout of the control system.
- In case the actuator has Analogue or Digital interface, the Fieldbus settings will be replaced by settings related to calibration and invention of input and output signals.

4. MAINTENANCE, SERVICE AND TROUBLESHOOTING

4.1 Maintenance

The QT4000 is in principle maintenance free; all bearings and gears are lifetime lubricated and components are designed to last throughout the actuator's lifetime. It is however recommended that the actuator is inspected regularly to reveal any damages caused by mechanical impact, corrosion etc. Top cover gasket and manual operation shaft seal should be lubricated with suitable lubricants if they appear to be dry.

4.2 Internal construction

All replaceable components are located inside the actuator's motor and electronics housing.

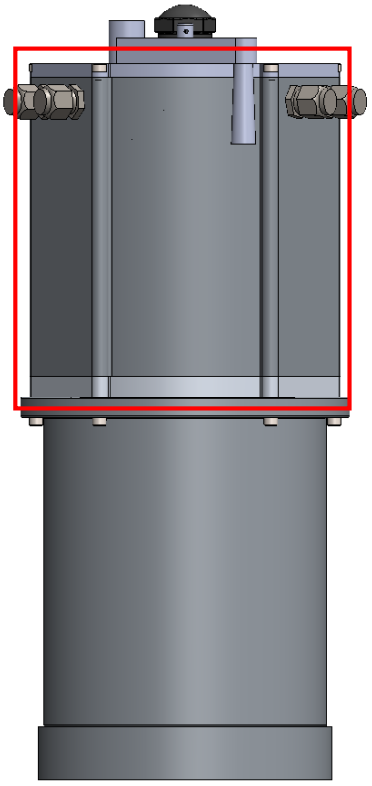


Fig. 15: Motor and electronics housing.

Remove the top cover to provide easy access to replaceable components.

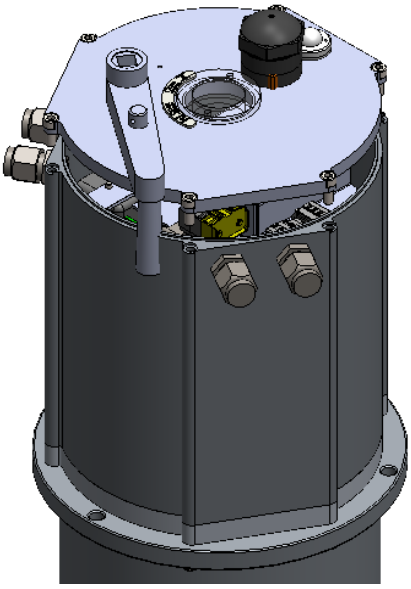


Fig. 16: Removing top cover.

Component overview:

1. Control interface and connection terminals
   Position sensor below interface
2. AC/DC Power supply
3. Interface-power supply connector
4. Interface-motor connector
5. Bracket PSU & Motor
6. Motor with manual operation shaft
7. LED/ Hall sensor PCB
8. Valve position indicator
9. 110-240 V AC/DC connection

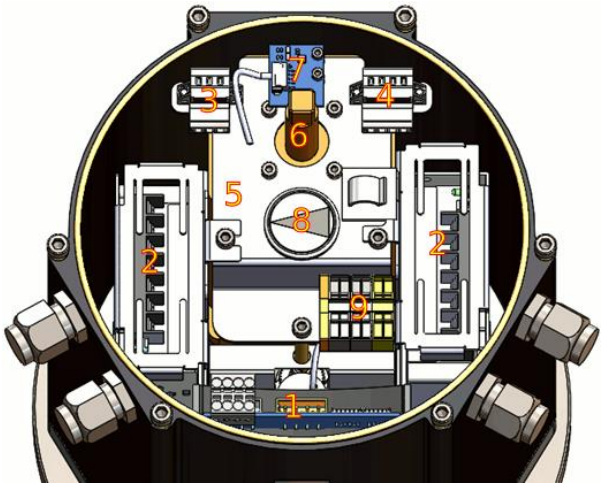


Fig. 17: Internal components.

4.3 Internal wiring

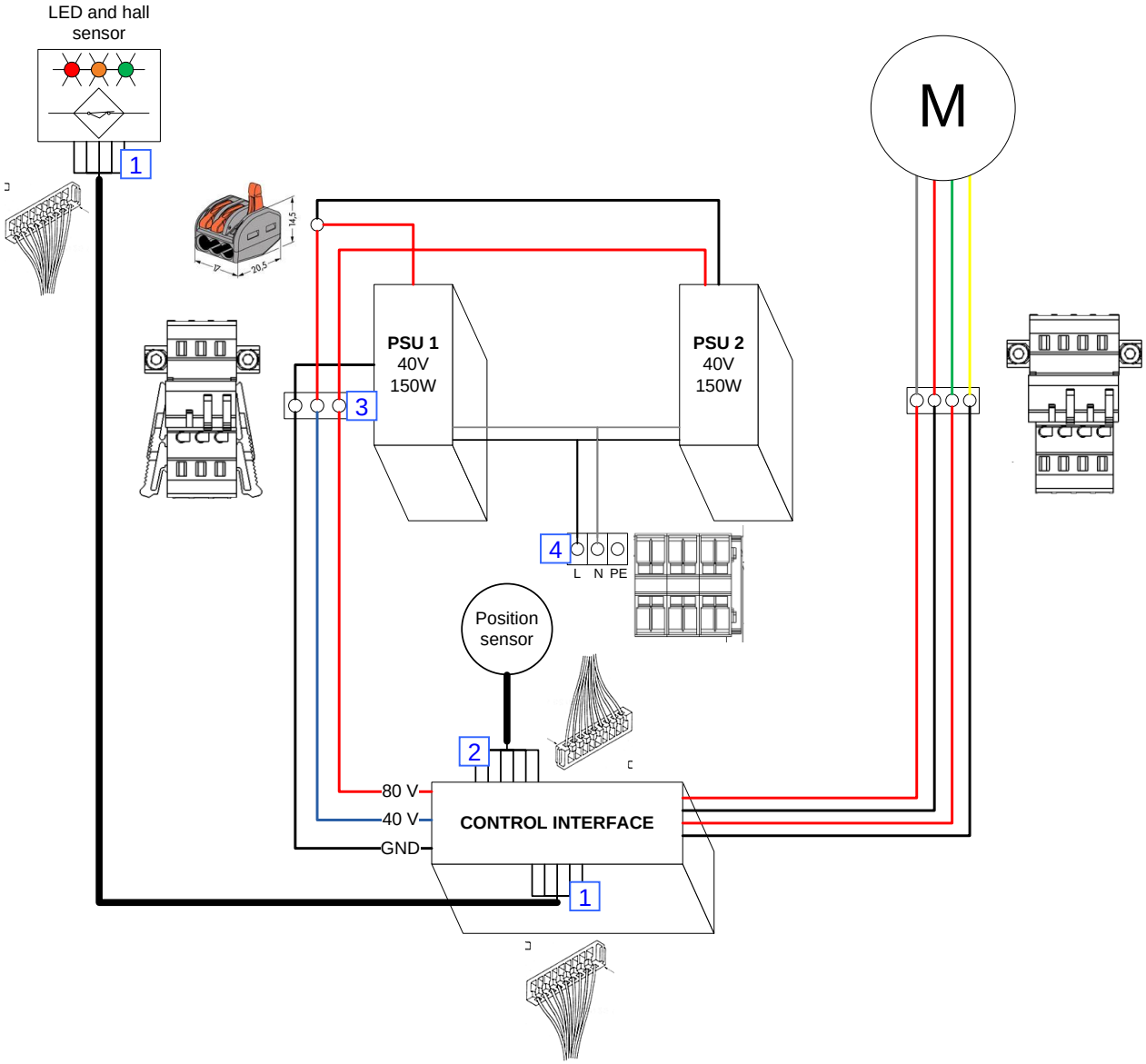


Fig. 18: QT4000 connection schematics.

Connection schematics explanation:

1. LED and Hall sensor is connected to Control Interface via a 5 pole cable with contacts in both ends.
2. Position sensor is connected to Control Interface via a 5-pole cable but with a 6-pole contact.
3. The actuator has 2 power supplies of 40V/ 150 W each. These are connected in series to supply 80V to the motor.
   The Control Interface itself is powered by 40V taken from one of the power supplies.
4. Both power supplies get supply voltage from the same connection terminals.

4.4 Interface replacement

The QT4000 has a modular design and it is possible to convert from one type of control to another simply by replacing the control interface.

1. Remove top cover as described in section 5.
2. Disconnect the interface from the power supply, motor, position sensor and LED/ Hall sensor PCB.
3. Loosen the interface fastening screw 3-4 turns.

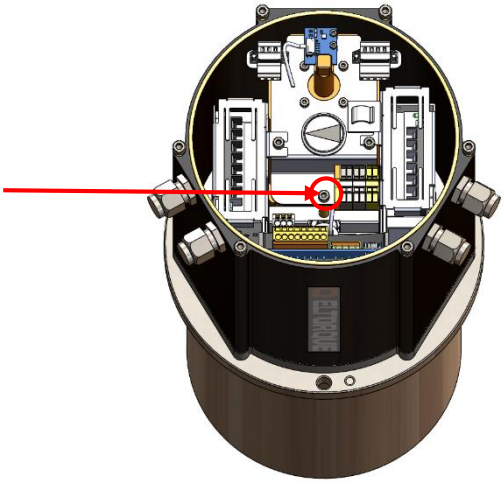


Fig. 20: Interface fastening screw.

4. Pull the interface slightly towards the outer housing and then lift it straight up.
5. To replace interface, follow step 1-4 in opposite order. The interface is equipped with 2 guiding pins in the bottom. These needs to align with the holes in the position sensor holder during replacement:

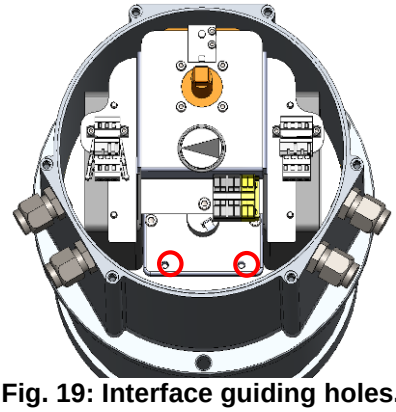


Fig. 19: Interface guiding holes.

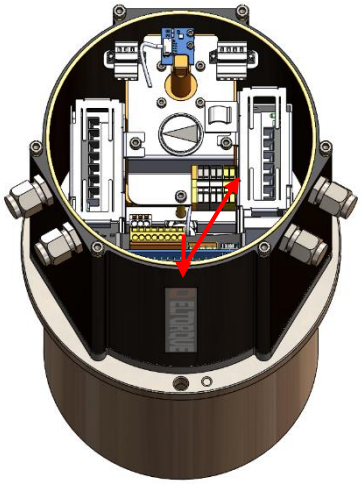


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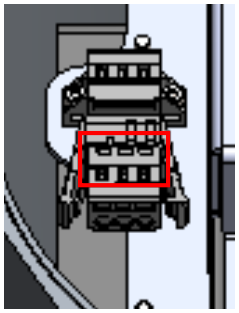
Fig. 20: Interface removal.

6. Re-configure actuator as described in section 0.

4.5 Troubleshooting

Problem description	Cause & solution
No light in indicator LED. No response from actuator on the control system.	No power supply, check fuses and wiring. Supply voltage can be checked using a voltage meter: - L-N voltage should be 110-240 V AC or DC. - Voltage on Interface-power supply connector should be 40V on black-blue wires and 80V on black-red wires. Press measurement probes into the connector grooves to obtain easy access to current conducting metal.  **Fig. 21: Interface - power supply connector.**
Indicator LED is Red The actuator does not respond to control signals. On a fieldbus system, the actuator gives torque alarm.	Manual operation shaft cover not in position.
Indicator LED is Red The actuator responds normally to control signals. On a fieldbus system, the actuator gives temperature alarm.	Actuator's internal temperature is 10° C or less from the motor current shut-down limit. If possible, allow actuator to cool down by leaving it in standby mode for 15 minutes or more.
Indicator LED is Red The actuator does not respond to control signals. On a fieldbus system, the actuator gives temperature alarm.	Actuator has over-heated and the motor current is shut down to prevent damage. Make sure surrounding temperature is within limits and that the duty type requirements are followed. See section 2 for more details.
Indicator LED is Red The actuator attempts to move valve when a control signal is given. On a fieldbus system, the actuator gives torque alarm.	Valve operation torque is too high, please check torque by manual operation. **OR** Actuator torque has been set too low, increase it by using Eltorque Manager 3 as described in section 0.
Indicator LED is "normal". The actuator does not respond to control signals. On a fieldbus system, the actuator is not available.	Faulty control system, please ask system vendor for support. **OR** Problem with control signal wiring, please contact local Eltorque agent for support.

5. APPENDIX

5.1 Terminology

Term	Description
Valve	A valve is a device that regulates the flow of materials (gases, fluidized solids, slurries, or liquids) by opening, closing, or partially obstructing various passageways. This manual mostly refers to quarter-turn valves with a 90 degrees movement between Closed and Open position.
Valve actuator	An electric device for operation of valves in various process control systems.
Valve flange	The surface of the valve which the actuator is fastened to. Most commonly it is holes for 4 screws, where hole size and distance between them is defined in EN ISO 5211 standard.
Valve adapter	A device used to connect the actuator to the valve spindle/ stem.
Control Interface	Electronic device controlling the valve actuator according to signals from an overall control system. e.g. PLC or other type of electronic controller.
Configuration	The set-up of parameters, which affects the actuator's performance and behavior.
Hazardous area	Area in which the permanent or periodical presence of explosive substances causes a risk of explosion.
PLC	A Programmable Logic Controller is a digital computer used for automation of industrial processes, such as control of machinery on factory assembly lines, measurement and control of process plants etc.
Digital Control	Simple control utilizing relays, on/ off switches and indicators. Allows only Open or Closed functionality for a valve actuator.
Analogue Control	Step-less control utilizing analogue current or voltage signals, e.g. 4-20 mA, 0-10 V etc. Allows positioning of the valve actuator between Open and Closed.
Fieldbus Control	A fieldbus is an industrial computer network for real-time distributed control of various devices, including valve actuators. When Eltorque valve actuators are controlled by Fieldbus, the functionality is extended in terms of positioning, commands, feedback and configuration.
Modbus	The Eltorque Modbus interface is using RS-485 serial communication utilizing the Modbus protocol. Modbus is a fieldbus which allows communication with max 31 actuators connected to the same "master-slave" network. "Master-slave" means that the Modbus controller is a master which actively sends commands and requests to the "slave actuators".

Term	Description
CANopen	The Eltorque CANopen interface is using the CAN (Controller Area Network) communications standard. CANopen is a fieldbus which allows communication between max 127 actuators connected to the same network. It is not a “master-slave” network (ref. Modbus), hence all nodes in the network can actively send messages at their own initiative. The communication is prioritized, meaning that urgent messages are transmitted and received before information with lower priority. Compared to Modbus, CANopen has the following advantages: • More reliable communication, i.e. it is more likely that the information transmitted is received correctly by the recipient. • More nodes pr network, max 127. • More control and configuration features available.

5.2 Ordering information

Part number	Description
4000.110.1	QT4000 1.0 w/DIGITAL Interface
4000.120.1	QT4000 1.0 w/CANOPEN Interface
4000.130.1	QT4000 1.0 w/ANALOG Interface
4000.140.1	QT4000 1.0 w/ MODBUS Interface
Control Interfaces	
4000.010.1	QT4000 DIGITAL 1.0 Interface
4000.020.1	QT4000 CANOPEN 1.0 Interface
4000.030.1	QT4000 ANALOG 1.0 Interface
4000.040.2	QT4000 MODBUS 1.0 Interface

5.3 Index

5.4 Control system examples

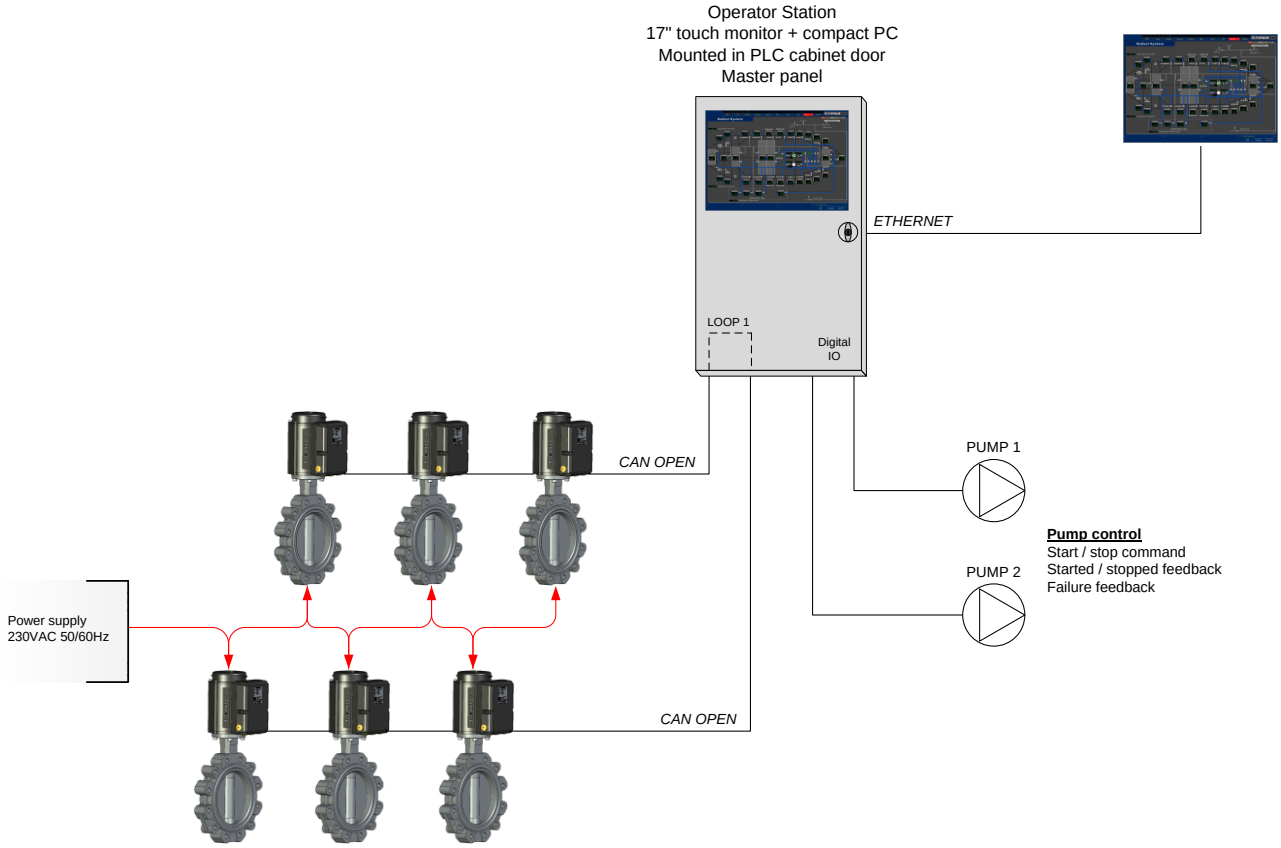


Fig. 22: Stand-alone valve and pump control with operator stations.

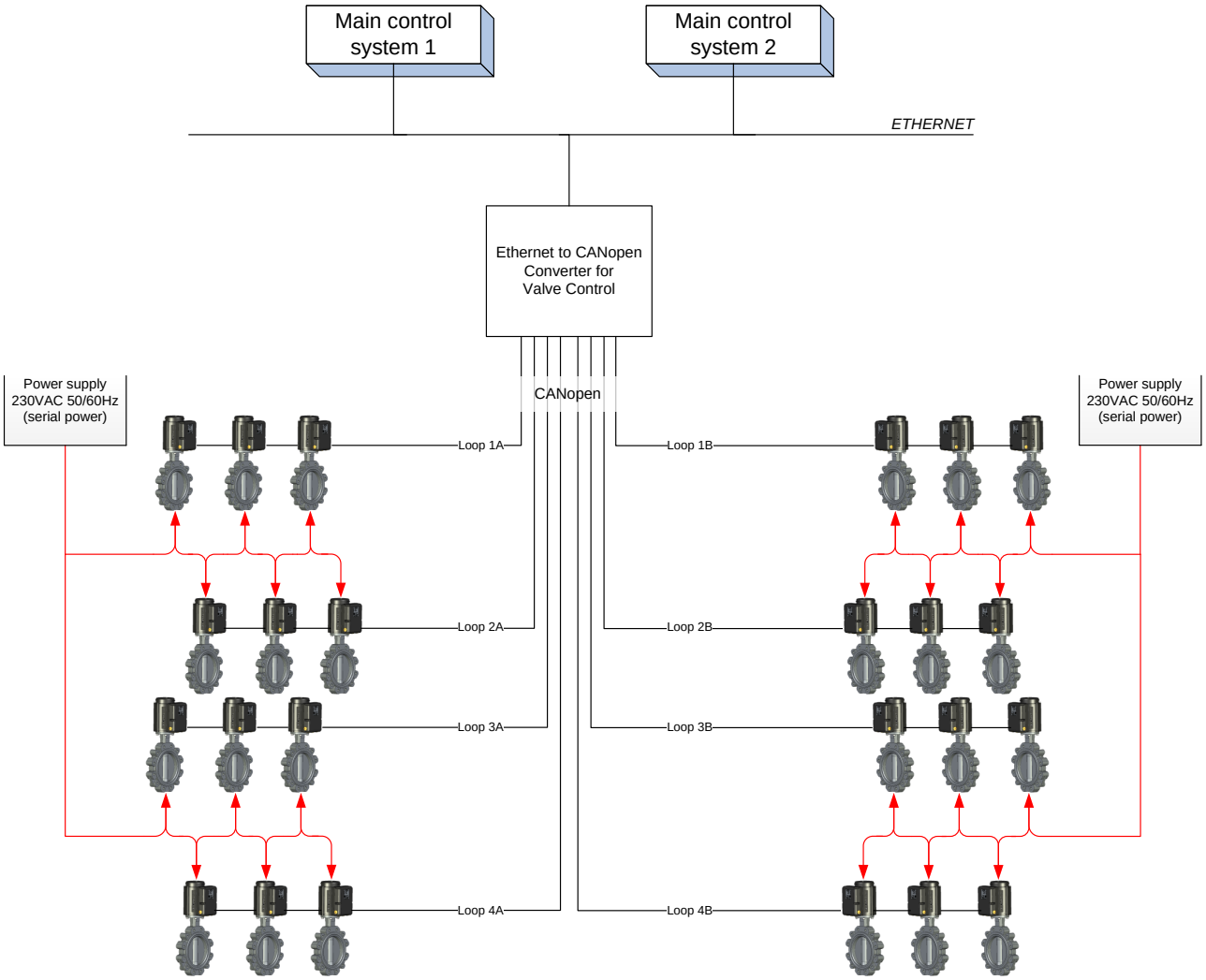


Fig. 23: Valve control system as an integrated part of a larger control system.

Notes